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Behavioral Analysis Of A System Consisting Of A 20-Story Structure RC Frame And A Shear Wall Using ETABS

Yogesh Ajmera [1], Anil Kumar Sharma [2]

[1] M. Tech Student, Department of Civil Engineering, Arya College of Engineering & Research Centre, Jaipur, Rajasthan, India

[2] Assistant Professor, Department of Civil Engineering, Arya College of Engineering, Jaipur, Rajasthan, India

ABSTRACT

In this paper present G+20 storey building modeled with and without shear walls in FEM based program ETABS.The inclusion of shear walls notably reduced the base shear, storey drift, and lateral displacement in comparison to models lacking shear walls. These results reaffirm the importance of shear walls in imparting seismic robustness and rigidity to multi-story structures. Hence, the incorporation of shear walls should be considered an indispensable facet in the design and construction of such buildings. The findings from this study can be applied to enhance buildings' resilience against seismic events by bolstering their seismic stability.

Keywords: - Multi Story, RC Frame, Shear wall, Lateral Forces, ETABS, G+20.

I. INTRODUCTION

A multi-story structure incorporating a reinforced concrete (RC) frame along with a shear wall is a prevalent structural configuration in contemporary construction practices. This architectural design combines the stability and load-bearing capacity of an RC frame with the enhanced lateral resistance and stiffness offered by a shear wall.

The RC frame serves as the primary load-bearing element, distributing vertical loads throughout the structure efficiently. It provides stability against gravity loads while supporting the overall framework of the building. On the other hand, the shear wall, typically placed strategically within the building's layout, contributes significantly to the structure's lateral stability. Its main purpose is to resist horizontal forces generated by wind, seismic activity, or other lateral loads, thereby mitigating structural deformations and enhancing the overall structural integrity.

The synergy between the RC frame and the shear wall is crucial in ensuring the structural stability, strength, and resilience of multi-story buildings. This combined structural system is extensively studied and analyzed by structural engineers to optimize its design, improve performance under various loading conditions, and ensure compliance with safety standards and building codes.

Understanding the interaction and behavior of the RC frame and shear wall within multi-story structures is fundamental in advancing structural engineering practices, contributing to safer and more resilient building designs. This study aims to delve deeper into the dynamics and performance of this composite structural system, exploring its behavior under different loads and providing insights for optimizing its design and functionality.

II. ETABS SOFTWARE

The ETABS, which stands for "Extended 3D Analysis of Building Systems," is a powerful and widely used software tool in the field of structural engineering. Developed by Computers and Structures, Inc. (CSI), ETABS serves as a comprehensive structural analysis and design software. It enables engineers and designers to model, analyze, and design buildings and structures of varying complexity.

This software is renowned for its robustness and versatility in performing sophisticated analyses of structures subjected to static, dynamic, and nonlinear loading conditions. ETABS offers a user-friendly interface coupled with advanced features that allow for the creation of accurate three-dimensional models of buildings and facilitates the evaluation of structural behavior under various loading scenarios.

Engineers leverage ETABS for tasks such as structural modeling, seismic analysis, design optimization, and performance-based design. It employs a range of analysis methods and tools to simulate and predict the response of structures, aiding in the assessment of their stability, strength, and overall performance.

ETABS continues to be a go-to software solution for structural engineers, providing them with a reliable platform to efficiently and effectively analyze and design buildings and structures in compliance with international building codes and standards.

Overall, we now have a better grasp of the non-linear response of shear walls thanks to the findings of recent studies on their seismic behaviour. The research has led to better shear wall-RC frame system design standards, reinforcement detailing practises, and analysis methods.

III. MODELLING OF PROPOSED STRUCTURE FOR G+20 BUILDING

Etabs 2020 serves as the software for constructing building models. A critical aspect of the structure modeling process involves assembling various structural components to depict both the visual and functional aspects of the structure. This portrayal showcases the structure's behavior when subjected to external loads. Within this process, joints are regarded as permanent fixtures, while beams and columns are recognized as integral structural elements.

The dimensions of the building components are designed for the most critical load combination using the relevant Indian Standards IS:456 2000 and IS:1893 2016.

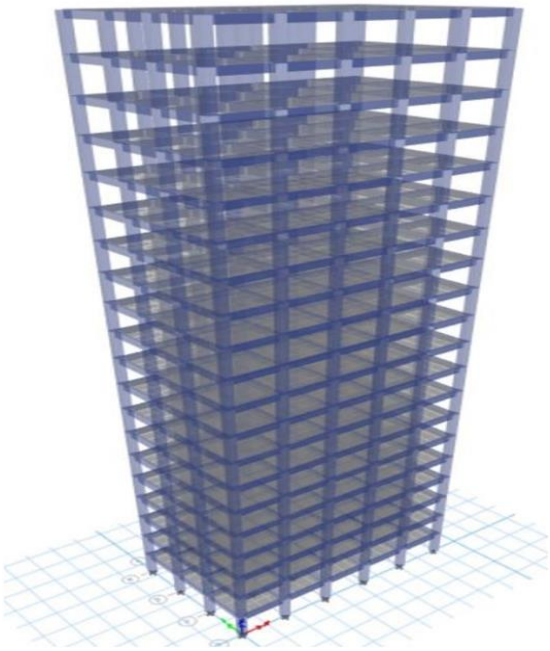

Figure 1. 3D view of model 1

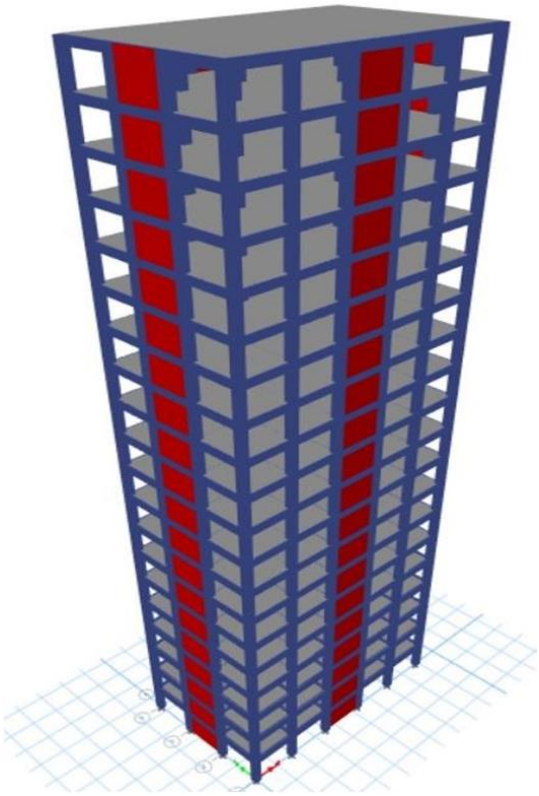

Figure 2. 3D view of model 2

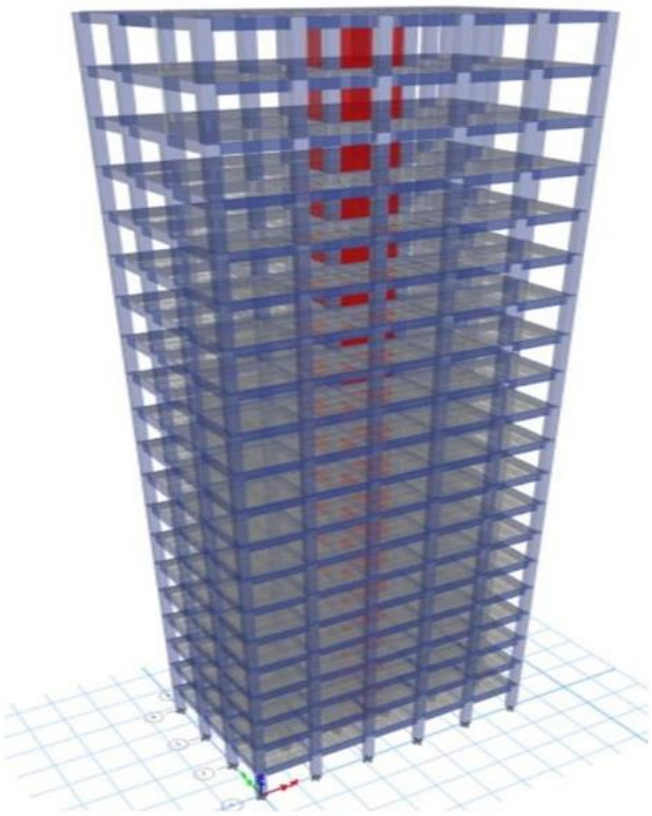

Figure 3. 3D view of model 3

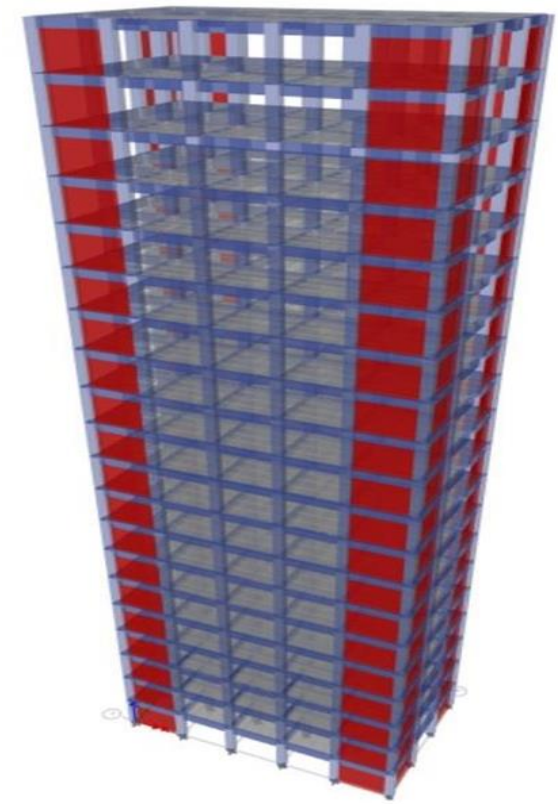

Figure 4. 3D view of model 4

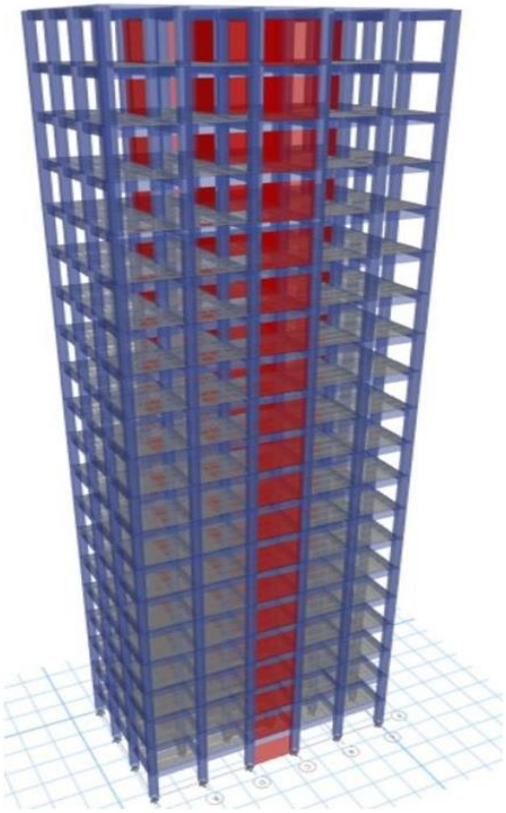

Figure 5. 3D view of model 5

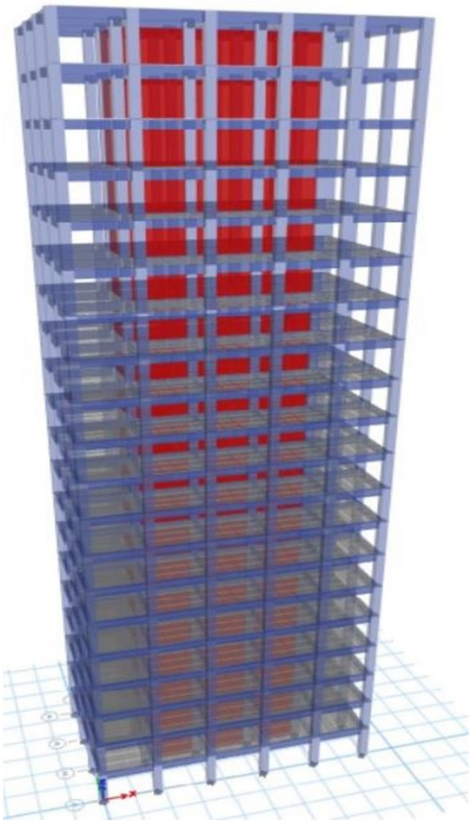

Figure 6. 3D view of model 6

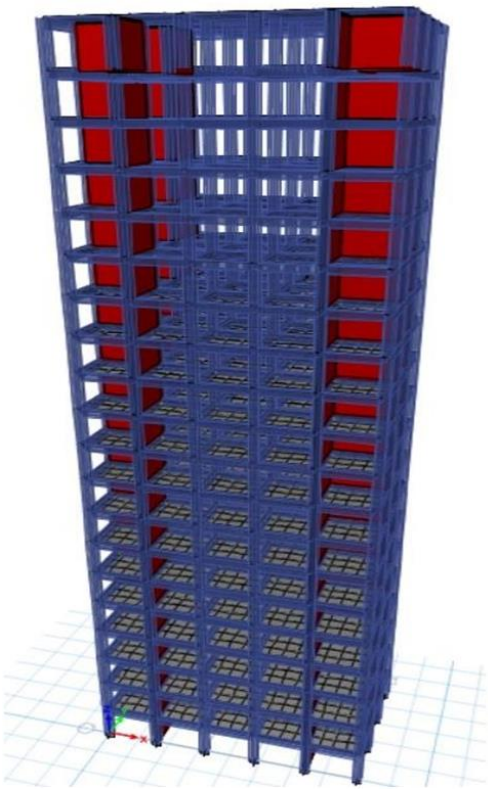

Figure 7. 3D view of model 7

IV. ANALYSIS OF MODEL

Conducting a pushover analysis that accounts for the interplay between shear walls and RC frames allows engineers to acquire significant insights into the seismic behavior of the structure. This analysis assists in pinpointing probable vulnerabilities, evaluating the collective capacity, and refining the design and specifics of the shear wall-RC frame system.

We employ ETABS software to establish the model, defining load cases encompassing dead, live, and earthquake loads in a structured manner. Utilizing distinct models for the analysis of this 20-story building, we thoroughly examine the Pushover analysis and the dynamic interaction between the shear wall and RC frame. Various models were created and analysed to assess their interaction and behavior.

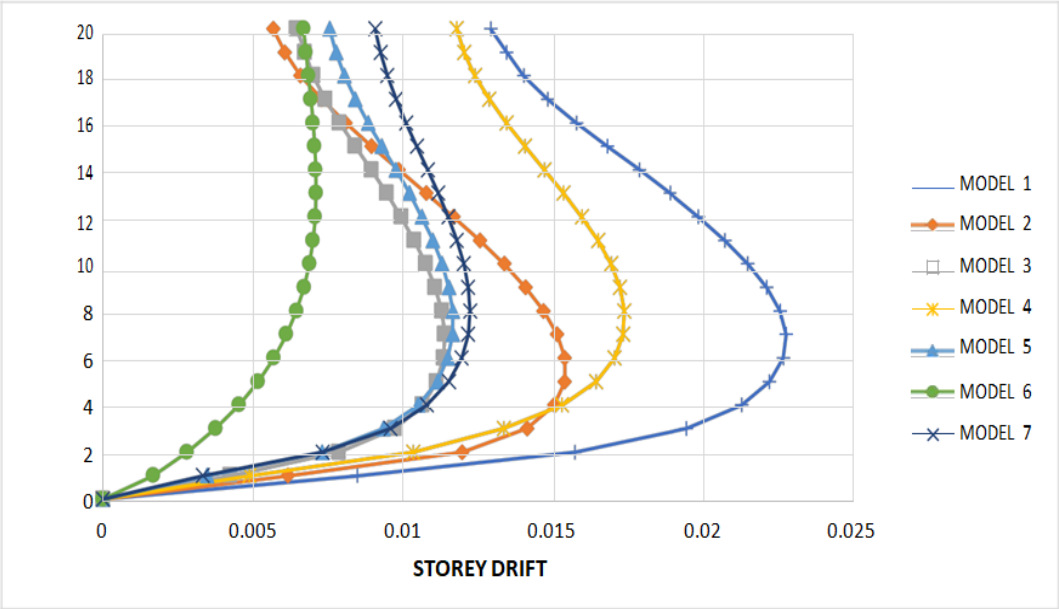

Figure 8. Stories drift at X for Model 1-7

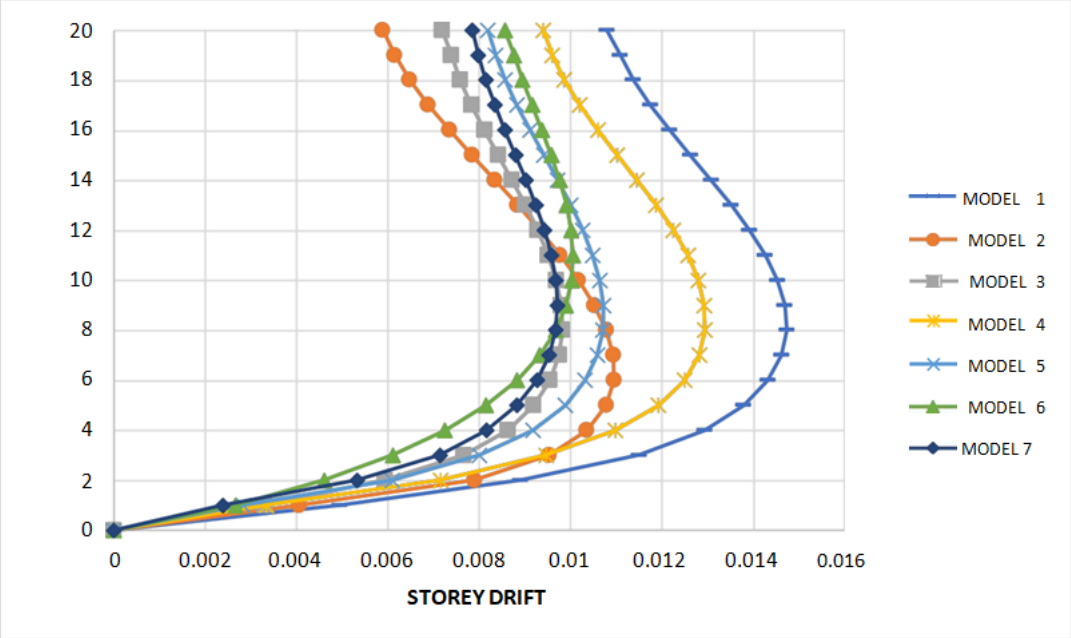

Figure 9. Stories drift at X for Model 1-7

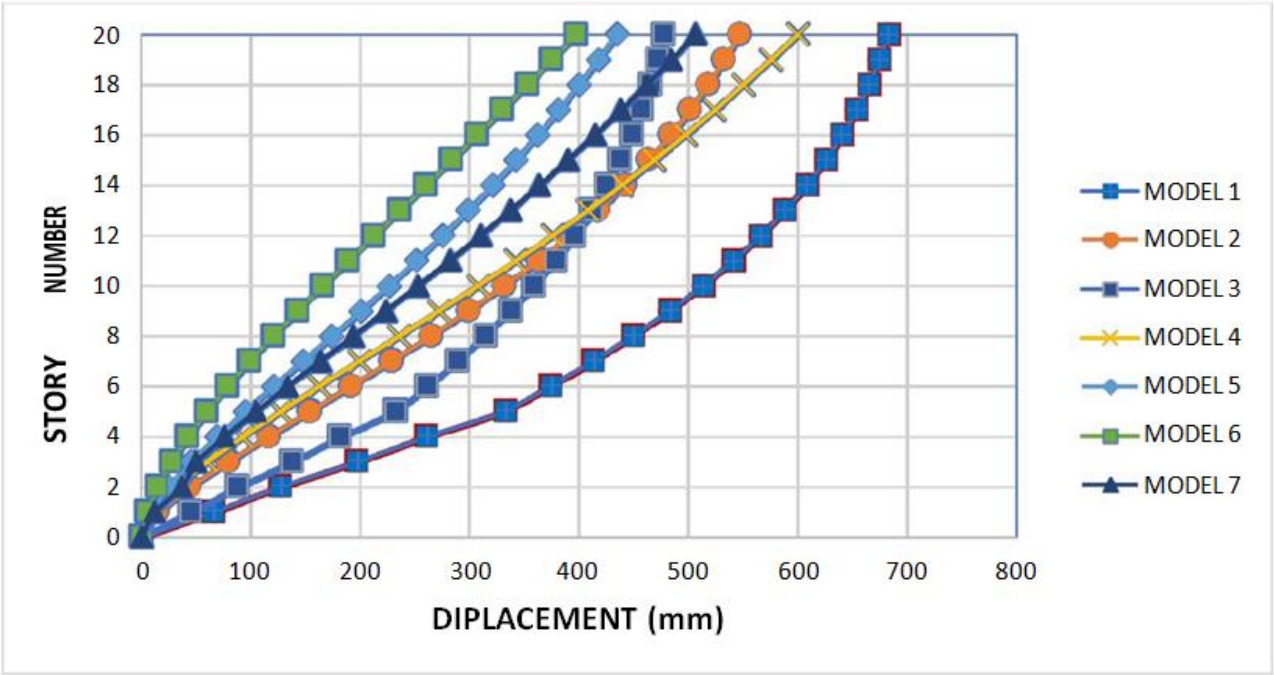

Figure 10. Stories maximum drift at X for Model 1-7

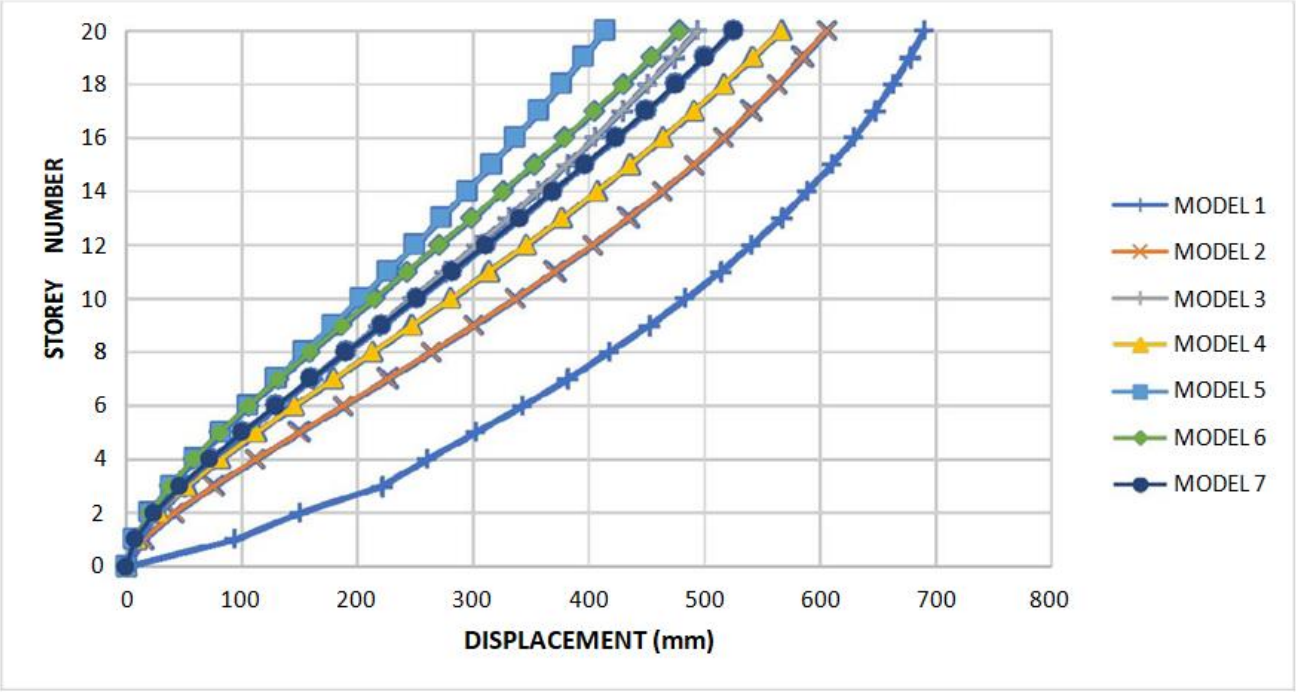

Figure 11. Stories maximum drift at Y for Model 1-7

V. CONCLUSIONS

Summarizing the research findings, the pushover analysis highlighting the interplay between shear walls and RCC frames emerges as a pivotal element in seismic building design. Shear walls offer substantial lateral load resistance, complemented by the structural stability contributed by RC frames. The figures depicted in the results reveal diverse outcomes based on the various interactions observed between shear walls and RCC frames in both axes.

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